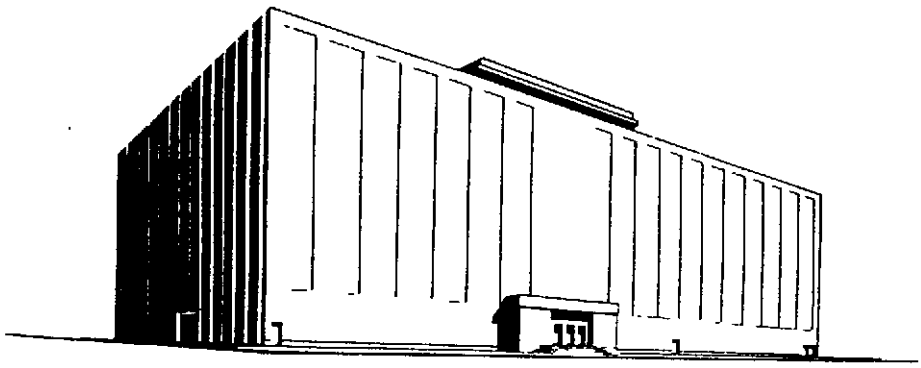


History of U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY

for the year

1962

SAN FRANCISCO CALIFORNIA

TABLE OF CONTENTS

PHOTOGRAPHS

CHAPTER I -- 1962 - BROADENED RESPONSIVENESS

The mission remained as follows: To conduct basic and applied research on nuclear and thermal radiation from nuclear explosions, natural and controlled nuclear processes, and nuclear accidents and incidents, including chemical, physical and biological processes and effects, associated phenomena and dispersion and contaminating effects of radioactive materials; to develop and evaluate radiac devices and systems, shielding equipment and materials, medical countermeasures for modification of the biological effects of radiation, and reclamation and decontamination procedures and countermeasures; to conduct composite evaluations of nuclear situations, including inter-related effects such as blast and shock; to prepare data for technical and operational manuals and training; to develop use of radioisotopes and other tracer techniques in the above technological and scientific areas; and to assist all of the military services, other federal agencies, and Government contractors in assigned areas.

While no basic change occurred in the mission, the relative emphasis in the scientific program had to accommodate two major new requirements. First, additional need to strengthen our ties with the operating forces were required to insure the proper integration of the scientific results of the Laboratory research into material of direct use for military operations. Second, the Laboratory needed to remain responsive on short notice to multiple changes in the planned field test programs.

As one response to the first major requirement a new branch was set up in the Military Evaluations Division called the Operations Analysis Branch. This Branch's function is to be the central Laboratory unit for integration of its scientific program with the needs of the operating forces, interpreting the results of the program, and recommending operating doctrine and procedures that would best use the information developed. Close working relationships and contacts with the operating forces are a characteristic of the modus operandi of this branch.

The second requirement, to be ready to make full use of field tests planned, placed unusual operating demands on the Laboratory. These demands resulted from:

1. Concurrent field tests in widely separated geographical areas, at sea as well as on land.

2. Delays in actual test schedules during implementation.

3. Multiple requests for new test proposals with substantially varying guidance before the results of already completed tests are known.

4. Additional projects initiated on tests already scheduled or underway.

5. Uncertainty as to whether any of the tests for which proposals are required will ever be executed.

While remaining responsive to the conditions described, it was necessary to retain the Laboratory's scientific excellence in the face of new assignments related to the space effort, the ocean environment and civil defense research programs.

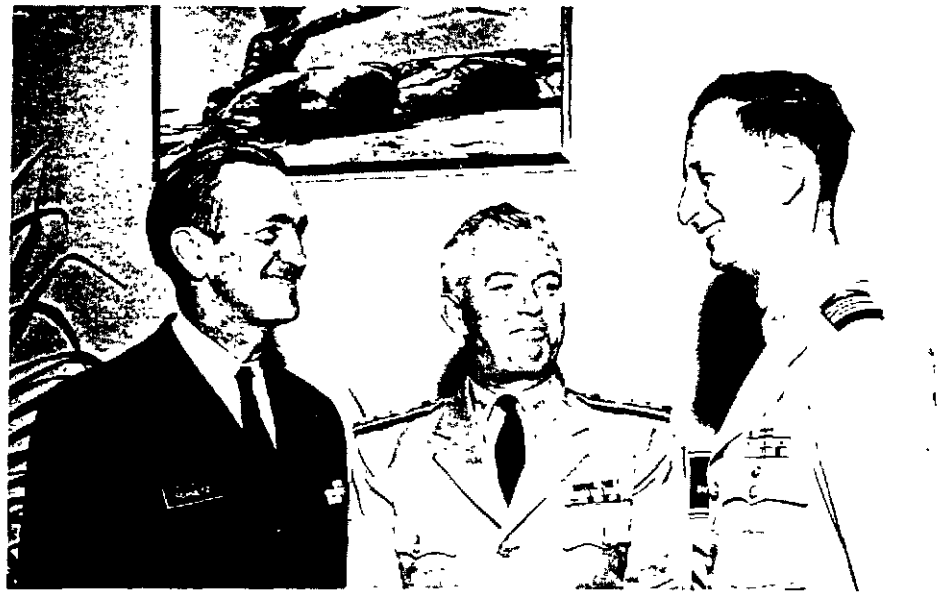
FIELD OPERATIONS COMMENDED

SWORD FISH

The Laboratory received a dispatch from the Chief of Naval Operations which relayed word from The Honorable Harold Brown, Director of Defense Research Engineering, commending NRDL on its planning, execution and technical reporting of the Sword Fish Pacific field test. "Aside from the outstanding performance of all members of the team," he said, "the nature of the report is particularly to be commended."

SMALL BOY

The Laboratory also received a letter from the office of the Director of Research of OCD stating they considered "the efforts of the project personnel resulted in the most successful group of field projects in fallout studies that have ever been carried out," and commending project personnel for their performance in spite of short lead time and project delays which required personal sacrifices, extended hours of hard work, ingenuity, and technical insight.



COMMON INTEREST -- The present Commanding Officer and Director, CAPT E.B. Roth, confers with three former NRDL C.O.'s: (top) at the Pacific Fleet Maintenance Conference with RADM F.B. Schultz (1957), C.O., Puget Sound Naval Shipyard; and RADM J. J. Fee (1947-50), C.O., Long Beach Naval Shipyard; and (bottom) during the 6th Navy Science Symposium with CAPT J. H. McQuilkin (1957-60), Assistant Chief of the Bureau of Ships for Research and Development.

MAJOR PERSONNEL CHANGES

CIVILIAN

HEALTH PHYSICS DIVISION

Albert L. Smith, a NRDLER since 1951 in the Radiological Safety Branch and in charge of that group for the past seven years, was promoted to Head of the Health Physics Division. He replaced A. L. Baietti, who was appointed Health Physics Consultant to the Scientific Director and subsequently resigned to accept a position in private industry.

NUCLEONICS DIVISION

When Dr. C. Sharp Cook, former Head of the Nucleonics Division returned from a year's leave of absence on a Fulbright Fellowship at Aarhus University in Denmark, he was selected for the position of Physics Consultant to the Scientific Director.

Dr. William E. Kreger was chosen as Head of the Nucleonics Division, succeeding Dr. Cook.

MILITARY

SENIOR PROGRAM OFFICER

CDR T. L. Birch, USN, BUWEPS Program Officer and formerly Administrative Director, relieved LCDR T. W. Robinson, Jr, USN, as Senior Program Officer. LCDR Robinson reported to BUSHIPS for duty.

ADMINISTRATIVE DIRECTOR

CDR Gale L. Bergey, USN, Officer-in-Charge of the Radiological Control Team, was assigned the collateral duty of Administrative Director.

NEW BILLET

Major R. T. Trolan, Chemical Corps, USA, reported as Liaison Officer to the U. S. Army Material Command, a new command established by the Army's reorganization which combined the technical services.

OTHER OFFICER ASSIGNMENTS

LCDR J. W. Ingalls, USN, relieved LCDR (w) C. H. Day, USNR, as Security Division Officer. LCDR Day resigned from the Navy for the role of civilian housewife. LCDR G. W. Werner, MSC, USN, relieved CDR R. C. Will, MSC, USN, as Radiobiological Assay Section Head. LCDR Will received orders to the U. S. Naval Hospital, Bethesda, Md. LCDR A. G. Opitz, USN, reported from the San Francisco Naval Shipyard and is the BUSHIPS Program Officer. LTJG W. E. Smith, IV, USNR, was released to inactive duty and returned to school. LTJG A. D. Dirvianskis, USNR, relieved LTJG W. G. Sadler, USNR, as BUPERS Program Officer. LTJG Sadler was released to inactive duty. LT J. S. Connolly, USNR, who had filled in as BUSHIPS Program Officer is now a full time Scientific Research Investigator in the Chemical Technology Division.

ORGANIZATIONAL CHANGES

The chart on page 7 shows graphically the organization of NRDL as of 31 December 1962. Changes made during the year include:

Code 170, Resident Representative at Camp Parks, was established. This Resident Representative, CDR G. L. Bergey, USN, is direct representative for the Commanding Officer and Director in matters pertaining to overall conditions of NRDL activities at Camp Parks. He also assists and advises Department Heads in Camp Parks matters under their cognizance.

Code 730, Functions of the Health Physics Division were revised to emphasize radiological functions, safety operations and to exclude experimental and developmental work on a project basis. The Radiological Evaluation and Development Branch (Code 731) and the Radiological Safety Branch (Code 732) were disestablished and the Research and Development functions assumed by the Scientific Department.

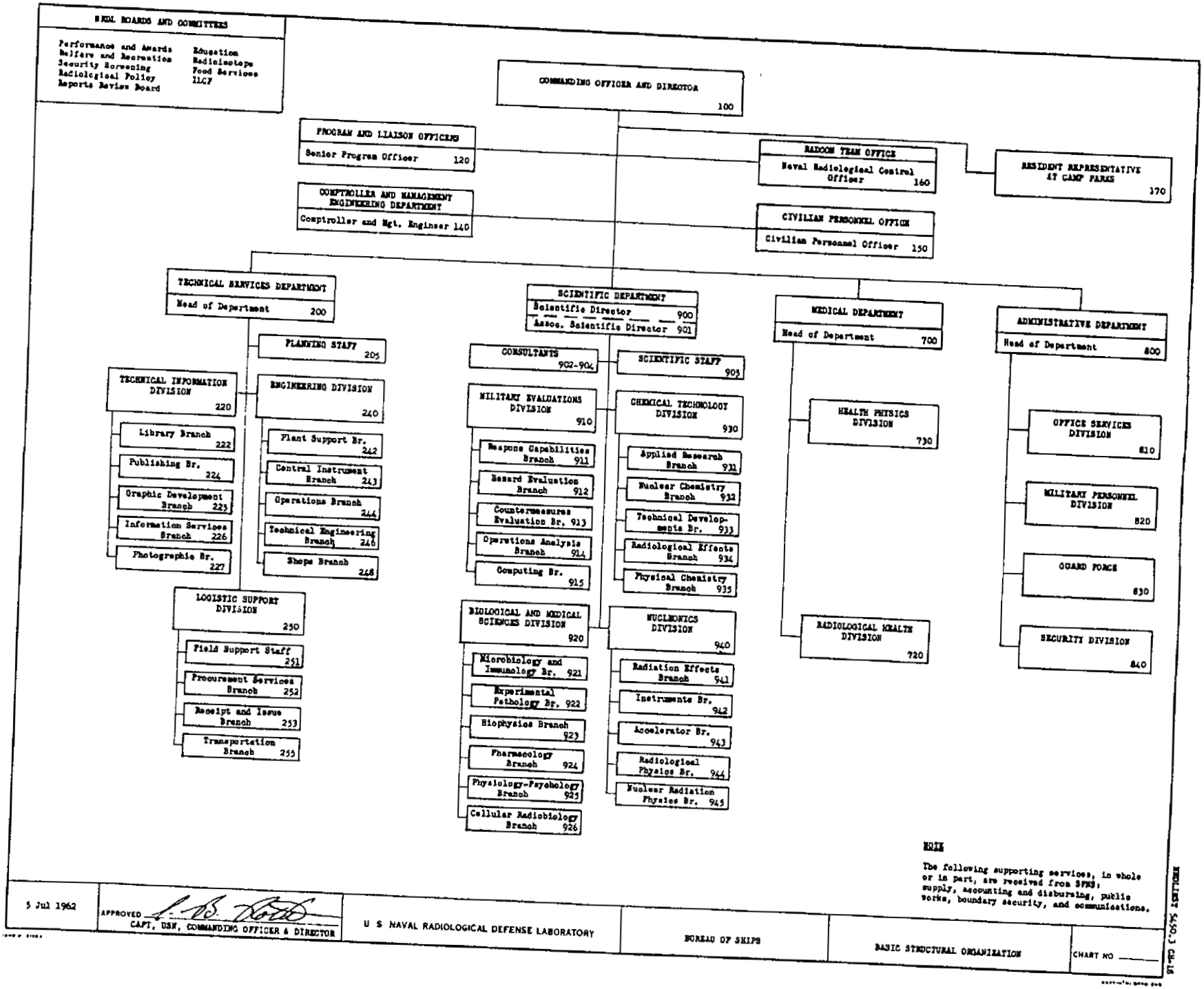
Within the Biological and Medical Sciences Division (Code 920) the following changes were made:

Biochemistry Branch (Code 921) was disestablished. The Microbiology and Immunology Branch (Code 921) was established. This Branch (1) Conducts research on the effects of ionizing radiations on the susceptibility of mammals to infection; studies the role of infection in the radiation syndrome and investigates prophylactic and therapeutic measures to prevent and treat such infections. (2) Conducts research on the immediate and long term injuries to the immune mechanisms, both humoral and cellular, induced by exposure to ionizing radiations, and on the recovery from such injury. (3) Investigates the mechanisms of transplantation immunity against normal and pathological tissues, and the modification of such reactions by ionizing radiations; studies the role of transplantation of hematopoietic tissues in the modification of radiation injury. (4) Conducts investigations into the possible antigenic changes induced in the animal by ionizing radiations which in turn may lead to the formation of post-irradiation neoplastic or malignant growths.

Functions of the following Branches were redefined to include - Experimental Pathology (Code 922), studies of late effects; Biophysics (Code 923), biospheric contamination studies; Pharmacology (Code 924), research concerning nutritional and environmental factors.

In the Military Evaluations Division (Code 910), the Operations Analysis Branch (Code 914) was established, having as its chief concern the development of optimum procedures for nuclear defense operations. Functions of the four previously existing branches were revised and restated for greater clarity.

There were no changes in the already comprehensive Mission, Tasks, or Functions of the Laboratory during 1962.


NRDL BOARDS AND COMMITTEES
Performance and Awards
Welfare and Recreation
Security Screening
Radiological Policy
Reports Review Board
Education
Radioisotope
Food Services
LLCF
COMMANDING OFFICER AND DIRECTOR 100
PROGRAM AND LIAISON OFFICERS
Senior Program Officer 120
COMPTROLLER AND MANAGEMENT ENGINEERING DEPARTMENT
Comptroller and Mgt. Engineer 140
RADCON TEAM OFFICE
Naval Radiological Control Officer 160
RESIDENT REPRESENTATIVE AT CAMP PARKS 170
CIVILIAN PERSONNEL OFFICE
Civilian Personnel Officer 150
TECHNICAL SERVICES DEPARTMENT
Head of Department 200
PLANNING STAFF 205
TECHNICAL INFORMATION DIVISION 220
Library Branch 222
Publishing Br. 224
Graphic Development Branch 225
Information Services Branch 226
Photographic Br. 227
ENGINEERING DIVISION 240
Plant Support Br. 242
Central Instrument Branch 243
Operations Branch 244
Technical Engineering Branch 246
Shops Branch 248
LOGISTIC SUPPORT DIVISION 250
Field Support Staff 251
Procurement Services Branch 252
Receipt and Issue Branch 253
Transportation Branch 255
SCIENTIFIC DEPARTMENT
Scientific Director 900
Assoc. Scientific Director 901
CONSULTANTS 902-904
SCIENTIFIC STAFF 905
MILITARY EVALUATIONS DIVISION 910
Weapons Capabilities Branch 911
Hazard Evaluation Branch 912
Countermeasures Evaluation Br. 913
Operations Analysis Branch 914
Computing Br. 915
CHEMICAL TECHNOLOGY DIVISION 930
Applied Research Branch 931
Nuclear Chemistry Branch 932
Technical Developments Br. 933
Radiological Effects Branch 934
Physical Chemistry Branch 935
BIOLOGICAL AND MEDICAL SCIENCES DIVISION 920
Microbiology and Immunology Br. 921
Experimental Pathology Br. 922
Biophysics Branch 923
Pharmacology Branch 924
Physiology-Psychology Branch 925
Cellular Radiobiology Branch 926
NUCLEONICS DIVISION 940
Radiation Effects Branch 941
Instruments Br. 942
Accelerator Br. 943
Radiological Physics Br. 944
Nuclear Radiation Physics Br. 945
MEDICAL DEPARTMENT
Head of Department 700
HEALTH PHYSICS DIVISION 730
RADIOLOGICAL HEALTH DIVISION 720
ADMINISTRATIVE DEPARTMENT
Head of Department 800
OFFICE SERVICES DIVISION 810
MILITARY PERSONNEL DIVISION 820
GUARD FORCE 830
SECURITY DIVISION 840
NOTE
The following supporting services, in whole or in part, are received from SFNS: supply, accounting and disbursing, public works, boundary security, and communications.
5 Jul 1962
APPROVED
CAPT, USN, COMMANDING OFFICER & DIRECTOR
U S NAVAL RADIOLOGICAL DEFENSE LABORATORY
BUREAU OF SHIPS
BASIC STRUCTURAL ORGANIZATION
CHART NO
NAVSHIPS 5450.3 CH-18

CHAPTER II

SCIENTIFIC ACCOMPLISHMENTS DURING 1962

In this section a brief description is given of a few of the accomplishments of the past year from the wide range of research and development projects at NRDL. These projects include such diverse activities as laboratory experiments, large scale experiments at Camp Parks and nuclear test experimentation at sea and at the Nevada Test Site.

RADIOACTIVITY AND NUCLEAR RADIATIONS FROM WEAPONS

Characterization of the radiological effects of nuclear weapons is still one of the problems of primary importance at NRDL. Considerable progress was made in 1962 in attempts to understand more about these effects.

Calculation of Radiological Effects of Nuclear Detonations

It became possible during the year to provide first-order calculations of any radiological effect from nuclear weapons for fixed or moving targets. Computer programs (or, in some cases, simpler charts and graphs) now exist to permit calculations of:

1. Transit radiation due to base surges from underwater detonations -- dose rate and total dose.

2. Transit radiation and deposit radiation from fallout (the program was considerably advanced for land-surface bursts, and with ability to make preliminary approximations for water-surface bursts).

3. Initial radiation from surface and low-air bursts.

4. Thermal radiation for surface and low-air bursts.

The computer programs can be easily modified to take countermeasures (for example, washdown) into account. A model also exists that permits determination of ship shielding protection for transit and deposit radiations.

In addition, technical work was completed on studies concerned with certain tactical uses of nuclear weapons, and report drafts on these studies reached the final stage of preparation. As a result of these studies, the Laboratory can

1. Compute the maximum burst height for tactical weapons of various types at which there will be significant local fallout.

2. Compute dose rates due to neutron-induced radioactivity resulting from air bursts of tactical weapons over some soils.

Radiological Effects from Underwater Nuclear Explosions

Study of the time-space distribution of the fission products and their associated radiations from underwater nuclear explosions proceeded on four fronts. Studies of the losses of activity to the ocean environment from a deep explosion were initiated in the variable pressure tank using an exploding gold wire as an energy source. A technique was developed to sample and measure the quantity of explosion products along the migrating bubble path by employing neutron activation analysis on the sampled gold wire dispersion. Study continued at the Camp Parks pond facility of early above-surface radiation history for shallow explosions. This was conducted as a phase of the Hydra IIA and Hydra IIB Programs. Positive evidence of the sensitiveness of depth in the blowout region in controlling the distribution of explosion products was obtained. The later atmospheric distribution of fission products is dominated by the base surge. A droplet coalescence model of the surge cloud was developed that describes not only the physical dimensions of the cloud as a function of yield, depth and time but as well the liquid water content and rainout at any point within the cloud. The last area of research involved a study of the residual radioactivity in the surface waters of the ocean, its concentration and history under the influence of oceanographic variables.

Nevada Test Site Measurements

NRDL participated in experiments at the Nevada Test Site during 1962.

For the purpose of simulating the nuclear radiation field from an air burst of a nuclear weapon, the Oak Ridge National Laboratory operated a bare reactor mounted on a 1500 foot tower at the Nevada Test Site (Operation BREN). In conjunction with the program NRDL measured the fast and slow neutron flux from the reactor as a function of reactor height, distance from the reactor, and depth in the ground. Results of this experiment indicate that neutron flux is a function only of slant range and soil moisture content but does not appear to be a function either of angle of neutron incidence at the detector or the chemical composition of the soil.

Extensive fallout debris collections and gamma ionization measurements were made at both of the land surface detonations of Operation SUNBEAM, Shots Small Boy and Johnnie Boy. At shot Small Boy fallout collections and radiological measurements were made out to a distance of 250 miles. The deposition dynamics of arrival time, mass deposition rate and time of cessation were measured by personnel in manned stations. Although the manned stations were specifically designed for use at Small Boy, the experience in design and performance of these shelters is directly applicable to the Civil Defense Shelter program.

Computer Programs for Recording and Analyzing Abundance and Decay Characteristics of Fission Products

Any of the several modes of nuclear fission will give rise to approximately 700 distinct radionuclides. The respective amounts of these nuclides remaining after fission vary with time as the nuclides decay. A series of computer programs was developed that will record and maintain a library of information on the initial distribution of fission products for different types of fission. A similar library will record the decay characteristics of each fission-product nuclide. The system will analyze the complex decay schemes of nuclide groups and calculate the abundance of each nuclide as a function of time. Later programs in the series will provide various forms of output. One program is currently set up for instantaneous fission, but with modifications, it can also deal with constant flux densities over specified time intervals.

Radiochemical Investigations

There are still many items of unknown experimental information needed to provide the type of computational information discussed in the above two sections. Among these are fission yields and energy spectral characteristics of many of the fission products, especially those of short half-life. During 1962 measurements of chain yields for products of thermal neutron fission of U^{233} were completed.

By employment of fast radiochemical techniques for tin, antimony and tellurium, relative abundances (i.e., independent fission yields) of either two or three members of fission product mass chains 131, 132 and 133 were measured. This is the first time this many independent yields have been measured along single mass chains. These new techniques make it possible for either antimony or tin to be separated from all other fission products within only 10 seconds after the end of an irradiation. The results indicate that:

1. Closed shells have a strong effect on independent fission yields over a narrow mass region, and

2. The width of the charge distribution curve in this region is appreciably smaller than that previously proposed from such empirical rules as the "Equal Charge Displacement" rule.

In addition, measurements of independent yields of the isomers Te^{133m} and Te^{133} gave information on angular momentum effects in fission.

Gamma-Ray Spectrometry

Gamma-ray spectrometry plays an important role in both laboratory and field measurements of weapons effects and in other NRDL experimental research programs. To be able to obtain significant data, both measurement and analysis techniques must constantly be improved. Some effort in 1962 went into improvement of these techniques in order that more reliable and more precise results can be obtained from future experiments.

Restricting the incident radiation to a small area of NaI(Tl) scintillation crystal improved the resolution of the crystal spectrometer by about 25 per cent and the peak-to-total ratio was found to be materially increased due to the Compton effect reduction. These effects were studied with a series of tapered lead collimators, all with the same apex but with differing apertures, in front of a 4 in. by 4 in. diameter NaI(Tl) scintillation crystal. Sources of gamma rays with energies from 0.28 to 2.76 Mev were located at the apex of the taper. Optimum compromise between the Compton distribution and the improved resolution (about 25 per cent greater than broad-beam resolution) was obtained with a 0.25 in. diameter aperture. Anomalous effects were observed with a smaller opening.

Gamma ray pulse height distributions are analyzed with the aid of a computer. The method is based on a library of standard distributions punched on IBM cards. To reduce a pulse height distribution into discrete peaks, appropriate standards are chosen from the library, and adjustment factors are provided so that the computer can fit the standards to the distribution. It removes each fit successively from the distribution and leaves a record thereof. The removal facilitates subsequent fits. The records comprise a set of reduced distributions from which can be deduced the gamma ray spectrum of the source that gave rise to the original distribution.

A number of commercial PN-PIN junction detectors, designed specifically for radiation detection applications, were procured along with a group of standard commercial high voltage silicon diodes. A testing program designed to determine the current potential of these devices for gamma radiation detection applications and to develop appropriate solid state circuitry for future use in portable devices was started. Tests were conducted to determine counting efficiency as a function of incident photon rate for various gamma energies. Data was obtained that also shows the excellent resolution capability of these devices for low energy gamma rays.

Sensitivities varying from five to several thousand counts/sec per mr/hr were observed and noise thresholds well below 100 kev equivalent were demonstrated.

Nuclear Structure

If knowledge of the early time radiations from nuclear weapons is to be improved, it is necessary to understand the nuclear processes taking place during the formation of the radioactive debris by fission or the production of neutrons in the fission and fusion processes in nuclear weapons. An understanding of the nature of the interactions between the emitted neutrons and the atomic nuclei of material in the vicinity of the detonation is also necessary and this understanding will come with a better knowledge of the physical laws governing the forces that hold the atomic nucleus together. Research on the fission process now underway should provide useful information regarding the forces within the nucleus.

As a part of the program for studying fundamental nuclear structure, the decay of Cd^{115} was studied with a gamma-ray spectrometer. The detailed study of the gamma-ray spectrum yielded useful information about the level structure of the In^{115} nucleus (the daughter nucleus of the Cd^{115} decay). In^{115} has 49 protons, one short of the "magic number" 50, and is of great interest in regard to current theories of the structure of atomic nuclei.

Nuclear Radiation Sources

Because of the importance of radiation sources to the NRDL program, the development and improvement of nuclear radiation source facilities is of prime importance to the work of many projects.

Improvements of the Van de Graaff Facility during the year were made by adding a neutron pit outside and immediately adjacent to the Van de Graaff building. This permits the production of neutrons in a relatively material-free environment and therefore provides a more nearly monoenergetic and isotropic point neutron source.

At Camp Parks work neared completion on the retractable source suspension system which will permit individual or simultaneous exposures to be made with five separate 3,000 curie sources.

This permitted proceeding with laboratory program plans which would eventually depend on use of a machine of its special capabilities.

Congressional approval was obtained for construction of a new 70-in. cyclotron. Current estimates indicate high intensity outputs of 20 to 70 Mev protons, adjustable up to 105 Mev by special temporary arrangements. This will be a unique facility in the U. S. and probably the world. Work proceeded on the determination of pole face configurations for the cyclotron magnets by measurements using the model magnet at NRDL. The contract for building construction is scheduled to be let by DPWO in January 1963.

NUCLEAR RADIATIONS FROM NON-WEAPON PROCESSES

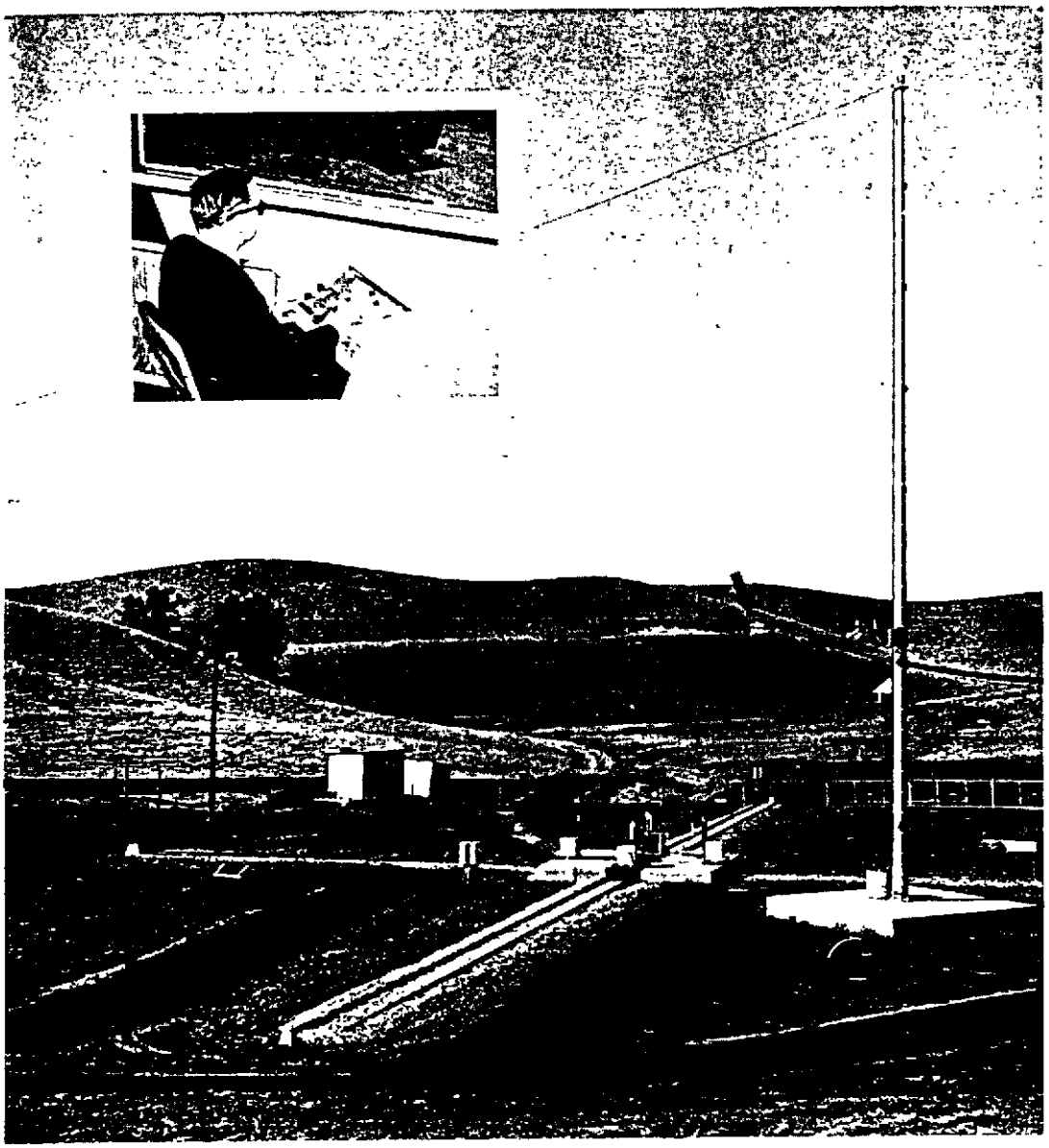
Besides the explosion of nuclear weapons the Navy and other government agencies have a number of areas of interest in which nuclear radiations are or may be of considerable importance. The solution of problems associated with the nuclear radiations from any source is a natural function for NRDL.

Evaluation of Radiation Hazards Associated with the Operation of Nuclear-Powered Space Units at the Pacific Missile Range

A report of general importance was published on the evaluation of radiation hazards associated with the operation of nuclear-powered space units at the Pacific Missile Range. This report describes the types of hazards to be expected and the extent of the hazard as a function of energy release. Consideration is given to contamination of land, air and ocean environments with radioactive nuclides. The evaluation permits one to establish criteria concerning types and strengths of nuclear power units that can be tolerated at specific launch sites. It also permits the establishing of operations criteria and countermeasure systems for the launch area.

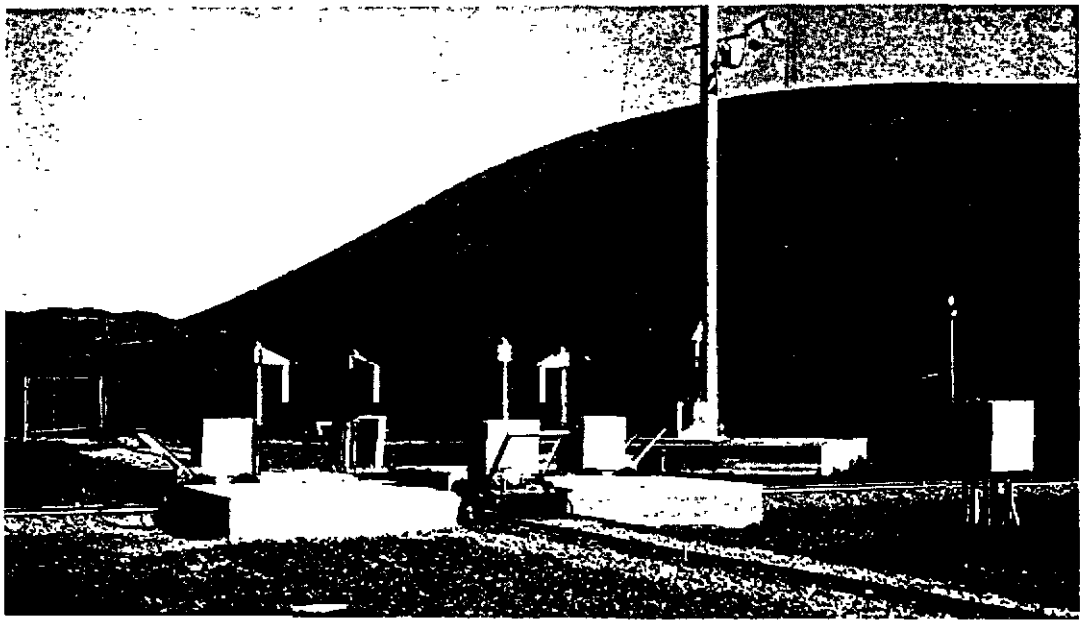
Radionuclide Release to Seawater

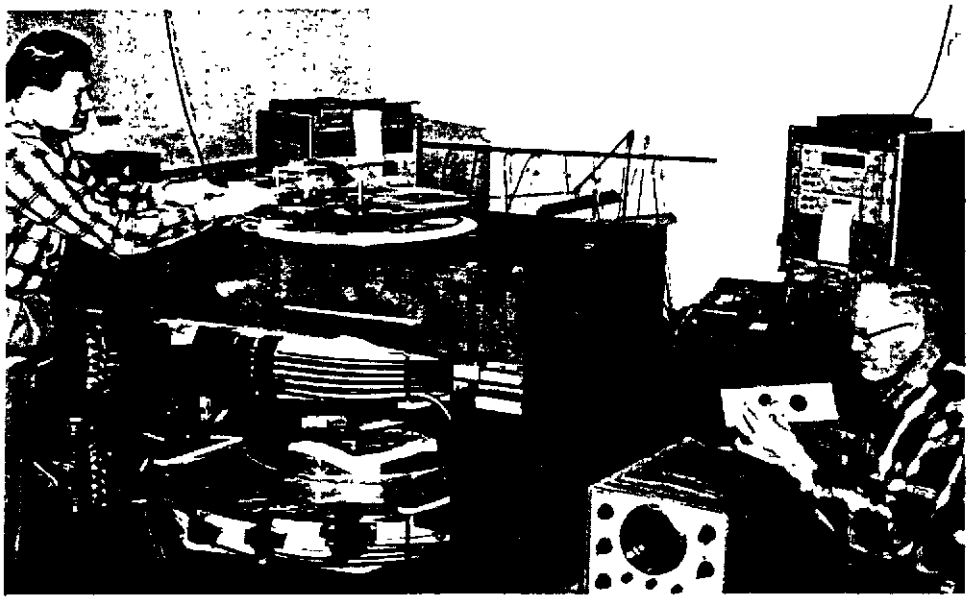
Investigations were started on the rate and extent of radionuclide release from nuclear power materials immersed in seawater. The dissolution behaviors of strontium titanate in 20^0C seawater, in the presence and absence of applied ionizing radiation, were evaluated. Experimental plans to define fission product release from special nuclear fuels were developed. The first fuels to be considered will be those scheduled for employment in the NERVA system. Release resulting from a simulated criticality excursion of the NERVA reactor will be investigated by use of a TRIGA pulsed neutron reactor. The ability of the pulsed neutron reactor to simulate the hypothesized NERVA criticality excursion was evaluated.



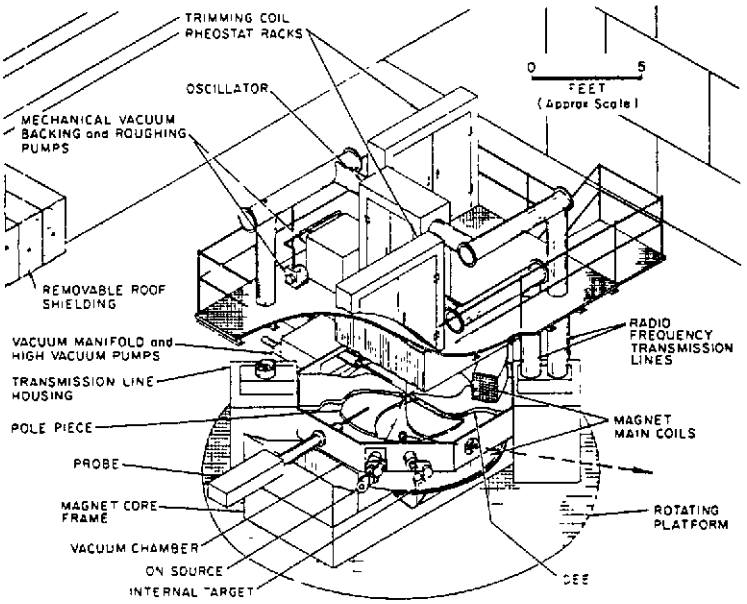
RADIATION FACILITY -- Located at Camp Parks in a 290-acre area comprising rolling hills which act as a radiation shield, this Radiation Facility has a total of 15,000 curies of Co^{60} in 5 sources (4 car sources, one tower source - 3,000 curies each) remotely operated at a 1600 ft. distance in the Control Tower(arrow). Shown in the lifted position, the car sources are operated by an electrical-pneumatic-hydraulic-mechanical system. The fence section can be removed. Inset shows H. W. Mey, who is in charge of overall engineering, at the Control Center.

CLOSE UP OF FACILITY -- (Photo at left) Keys to the 3,000 curie tower source are being held by Ken Miller (right), Project Head, and Robert Ferguson, Sergeant at Santa Rita Rehabilitation Center which provided much of the labor for the project. Looking on is Allen Dale, Head, Plant Support Shop at Camp Parks. (Photo below) -- For the engineering tests, the actual sources are replaced by dummy loads and source containers by wooden frames. One of the five test stations is shown at extreme right. It provides power and a panel for the set up of instrumentation. At the top of the test station is a flashing red warning light which lights when one of the sources is out of the container. The five test stations are connected with the Control Center by means of a 100 pair control cable. The sources are shown in the raised position. The maximum field of the car sources is about 1,000,000 r/hr. and for practical test purposes about 200,000 r/hr. The Radiation Facility was designed to provide a large uniform and a small extremely high intensity radiation field to meet the requirements of the Bio-Med., Chem Tech., and Nucleonics Divisions.





MODEL MAGNET -- (above) in which the pole-face configuration for the NRDL cyclotron is being determined. The shape of the surface of the pole faces is an important factor in the production of a high beam current in the cyclotron. John Hall (left) positions the magnetic field measuring equipment and Stan Williams adjusts the magnetic field control. (Below) Schematic drawing of cyclotron.



Peaceful Uses of Nuclear Energy

Radiochemical and physical measurements were made on fallout debris from the PLOWSHARE underground nuclear detonation, Project Sedan. Results from the analysis of all the collected data will permit a more reliable evaluation of the radiological effects which are produced by underground nuclear explosions developed for peacetime uses. Results indicate that radioactive isotopes are absorbed rather than adsorbed by soil particles since the specific activity is relatively constant for all particle sizes. Decay curves indicate a relatively uniform radiochemical composition for the fallout. It was found that iodine fission products volatilize and are released from the particulate fallout over a period of time.

In addition close working arrangements with the Atomic Energy Commission and Lawrence Radiation Laboratory were initiated to support the conventional explosion model work being performed as part of the PLOWSHARE program. This involves use of tracer techniques and evaluation of hazards.

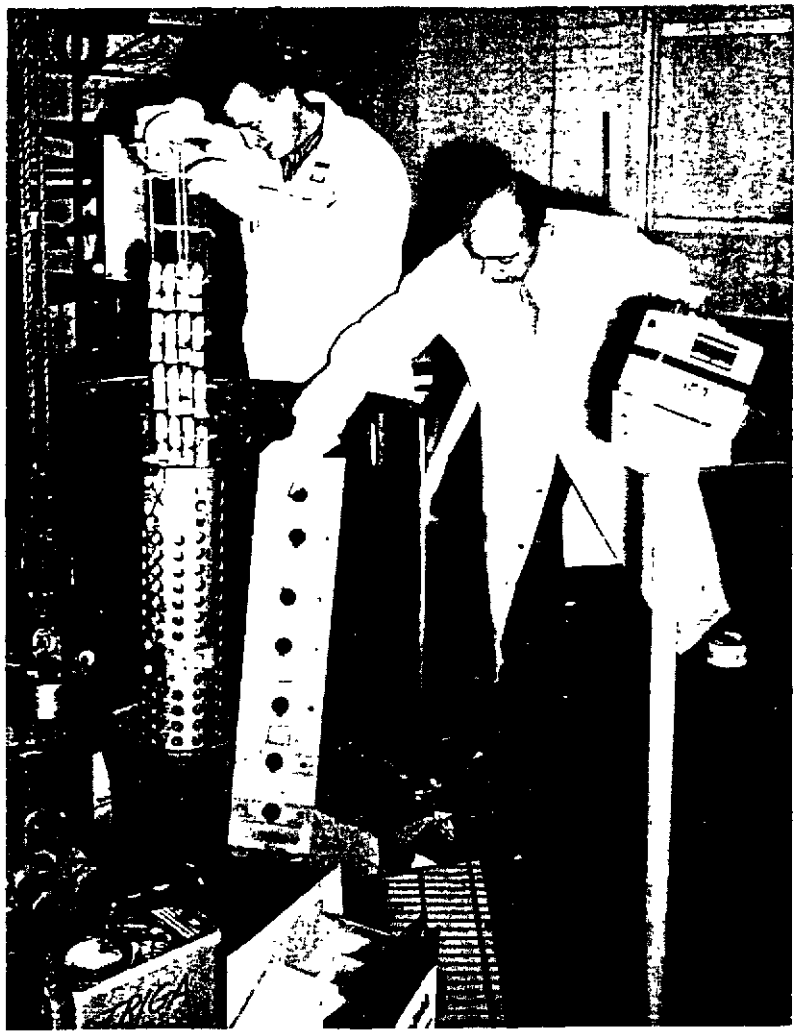
BIOLOGICAL EFFECTS OF IONIZING RADIATIONS

One of the primary ultimate purposes for getting information about the nuclear radiations from the various above-mentioned sources is to be able to evaluate the multiple problems associated with people, animals and plants exposed to radiation. To help solve this all important problem a considerable fraction of the NRDL research effort continued to be directed toward isolation and solution of the problems associated with the effects of nuclear radiations on biological systems.

Radiation Dose Effects

A comparison of recovery from acute radiation injury in eleven different mammalian species was carried out to determine the relationship between the recovery of the whole animal and of the blood cell forming tissues. The data accumulated to date show that small rodents require about twice the dose of radiation to kill 50 per cent of the experimental group than do larger animals. Furthermore, both systemic recovery and recovery of the blood cell forming tissues occur more quickly. This is not true, however, for all large animals; swine, for instance, recover rapidly.

A comparison of the effects of neutron and X radiation on the guinea pig indicates that death in this species is due primarily to injury of the blood cell forming tissue rather than to the gastrointestinal tract although injury to the latter does occur. The dose of neutron radiation necessary to kill 50 per cent of the animals was found to be 155 rads while 273 rads of X radiation were necessary to kill the same percentage of the animals.



TRIGA PROJECT -- Dr. John Ainsworth (left) and Robert Simpson place mice in animal cannister. A Triga Mark F. Nuclear Reactor has been used to study the effect of dose rate on mortality and recovery.

When animals are irradiated with less than lethal doses, they recover from a portion of the effects of the irradiation. The non-recovery portion is known as residual radiation injury and reduces the tolerance of the animal to subsequent exposures to radiation. Experiments have shown that residual radiation injury is highly dependent on the manner in which the radiation exposure is fractionated. Four exposures of 300 rads of X radiation to mice, three weeks apart, resulted in a greater residual injury than when the same total dose of 1200 rads was administered at the rate of 25 rads per day, five days per week.

Radiation Effects on Physiological Functions

In a behavioral study designed to detect the most immediate reaction of the intact nervous system to ionizing radiation, rats were exposed while asleep to X rays (250 kvp), and measurements of behavioral arousal and heart rate were made to indicate activation of the central nervous system. A transitory behavioral arousal was exhibited within 12 seconds at an exposure rate of 0.25 r/sec. At a higher dose rate of 1.9 r/sec this initial reaction increased in scope and by 30 seconds included sub-cortical activation as well, as indicated by a heart rate response. These reactions depended upon the rate of exposure and not upon the total dose. In blinded animals, exposure at the high intensity evoked both the behavioral arousal and the heart rate response. This indicates that CNS activation cannot be attributed to the direct effect of radiation on the visual receptor system. Although radiation may act as a stimulus to the CNS through other sensory systems it was also suggested that the nervous system itself is directly sensitive to ionizing radiation.

Studies on the effect of X irradiation on the active transport of sodium ions across the gastrointestinal wall have been carried out. This transport is accomplished by a bioelectric mechanism which is reduced by whole-body X irradiation at doses varying from 140 to 820 rads. Direct irradiation of the isolated living tissue has no effect. This would indicate that the reduction is due to the interaction of the extrinsic, autonomic nervous system, the activity of the mucosal cell layer and the presence of one or more unknown factors in food.

Whole-body X irradiation was found to alter blood pressure. A decrease was found in the peripheral and central (or aortic) pressure, although the change was not identical. The peripheral pressure was found to be more sensitive than the central pressure, that is, lower doses of irradiation were required to cause a drop in pressure measured at a peripheral site than at a central site. It would appear that this differential effect in blood pressure is a result of a radiation response in peripheral circulation.

The effects of radiation on carbohydrate metabolism in rats were investigated. Following irradiation, the injury is manifested by a higher liver glycogen level than that normally found. This "injury" persists for sixty to ninety days following irradiation.

A further effect of ionizing radiation was found to be an increased incidence of cancer in mice. Repeated weekly exposures to 5 rads over a fifty-two week period, caused a greater increase in malignant lymphomas than did a single dose of 260 rads. Exposure to fast neutron followed by injection of carbon tetrachloride, which stimulates liver cell division, resulted in a higher incidence of liver tumors than did irradiation alone. These data suggest an important relationship between stimulation of cell division and development of cancer in irradiated cells.

Bone Marrow and Immunology Studies

A continuing area of study was concerned with the therapeutic effects of bone marrow transfusions to protect against the lethal effects of X irradiation. This included studies on the acceptance of foreign tissues by normal and irradiated animals and the effects of the foreign tissue on the recipient animal. The normal rejection of foreign tissue is impaired by exposure to radiation. The dose required is dependent on the animal species. In mice, a lethal dose of irradiation is effective; in dogs, even a supralethal dose does not suffice. However, a combination of injections of 6-mercaptopurine or urethane and 900 rads of X radiation permits the successful transplantation of foreign bone marrow in dogs. It was found that mice given sublethal whole-body X radiation plus urethane injections will accept foreign skin transplants for periods up to five months.

The time of rejection of foreign tissues is dependent in part at least on the type of tissue transplanted. Thus, it has been shown that lethally irradiated mice will initially accept both rat bone marrow transplants (which protects some of the mice from the lethal effects of the irradiation) and skin transplants from the same rats. However, in mice surviving longer than fifty days, the greater number will reject the skin graft but will maintain the rat bone marrow and blood cells derived from it. It is known that the mechanisms for rejecting these two types of transplants are different. The reaction against skin and other "solid" grafts is carried out by lymph node cells, while the rejection of bone marrow and similar tissues is the result of the formation of a blood protein known as "antibody", which reacts specifically against the foreign substances. Hence it would appear that the cellular response recovers from irradiation injury, whereas the ability to manufacture antibodies either is not recovered at all, or if it does occur, recovery is delayed.

The therapeutic effect of bone marrow transfusions is due to the replacement of blood cell forming tissues. 1962 investigations showed that a similar effect can be elicited by the injection of cells obtained from the abdominal cavity or of white blood cells, but not by cells obtained from lymph nodes or the thymus. Larger numbers of the abdominal cavity cells and white blood cells are required than of the bone marrow cells, indicating that a smaller number of cells giving rise to red blood cells are found in the first two sources than in the bone marrow.

DOSIMETRY

Dosimetry is a key element in all experimentation and measurement of radiation effects. In some experimental and in militarily important situations as well the absorbed energy is an adequate measure of the dose received and the radiation effect. In many cases measurement of this apparently simple quantity can be difficult if there is the usual requirement that the measurement be made independent of the system being exposed. This problem can be made even more complex if the secondary interactions of the system with the radiation are important as in most neutron experimentations. Therefore, the dosimetry program is guided by the demands of the other experimental programs and is of fundamental importance.

Neutron and Gamma-Ray Dosimetry

Standardization of emission rates from major Laboratory neutron and gamma-ray sources was accomplished. The principal continuing effort was directed to development of a calorimetric method for absolute measurement of absorbed dose. Correlation of calorimetric measurements with alternate dosimetric techniques developed over the past five years indicates that a high degree of accuracy and internal consistency has been achieved. These measurements apply directly to all reported dose values associated with biological exposures and instrument evaluation studies. During the year a reactor neutron dosimetry program was initiated in connection with biological irradiation studies.

Dosimetry for Evaluating Radiation Effects from Heavy Particles

The biological significance of heavy nuclei irradiation, such as that encountered in space, is not well understood at present. This study is concerned with characterizing mechanisms by which heavy nuclei produce radiation damage and thereby provide the basis for heavy particle dosimetry. Nuclear emulsions were exposed to particles from a heavy-ion linear accelerator to study parameters best suited for evaluating the distribution of energy transfer. These measurements indicated that relatively straightforward techniques can be developed for identifying particle charge and energy loss.

THE FARM -- Feeding time at the NRDL Large Animal Facility at Camp Parks

RDGI-1 Dosimeter Ratemeter

A combination ratemeter-dosimeter was developed which used the recycling detector as the input to a rate-measuring circuit, and to a separate dose-measuring system. This instrument measures gamma intensities on three linear scales of 0-10, 0-100, and 0-1000 r/hr. Also, it totalizes dose received in 0.1 r increments up to 1000 r. When the ratemeter is exposed to Co^{60} from the front, accuracy of the rate function is ±10 per cent of the true value, and of the dosimeter ±10 per cent or 0.1 r, whichever is greater, in the temperature range -40 to +50° C.

The unit is powered by two size C nickel-cadmium rechargeable cells which will operate the instrument in excess of 40 hr before recharging is necessary. The package is only 4 by 4 by 7 in. in size, and weighs less than 3 pounds, including battery.

Low Rate Portable Counter

A self-powered digital-readout accessory has been developed which significantly improves the readability of the low ranges of count-rate type radiacs. The Low-Rate Portable Counter finds its usefulness at rates below 5,000 counts per minute. The instrument employs transistor circuitry, internal battery or 115-v AC for power, and a timer which provides four fixed time intervals. It is small and simple to operate and the modular construction permits easy field maintenance.

Radiofrequency Interference (RFI) and Radiac-Telemetry Systems

With the imminent advent of radiacs equipped with telemetry systems for transmitting radiac data, it was anticipated that problems in R-F interference might arise. Furthermore, data accuracy can be reduced by bandwidth limitations of the telemetry system. The results of an evaluation of these potential difficulties showed that significant data errors can result from this interference, but that the effect of bandwidth limitation on the recorder output was small and that system accuracy and reliability was not lowered importantly. It was determined that these errors can be corrected satisfactorily through the use of common RF elimination techniques.

Nuclear Early Warning and Radiological Data System (NEWRADS)

This system is intended to give ship commanders two types of tactical information. A detection and early warning (precontact) subsystem will consider distant events; an installed shipboard radiac (environmental) subsystem will describe the immediate situation. Development of the latter was begun using a multistation detector concept with both individual and centralized readout stations. Readout will be in terms of dose rate and

integrated dose; close attention is being paid to the human engineering aspects of the display to insure maximum data assimilation in the shortest possible time. Requirements for this system were based on weapons effects data and reports on ship operations in nuclear environments. A contractual effort was initiated to determine the naval operational requirements for the precontact subsystem, and, on the basis of these needs, to establish the feasibility of and, if feasible, to develop a preliminary design of the subsystem. The contractor will relate the proposed precontact subsystem to the environmental subsystem so that the resulting NEWRADS will be an effective, coordinated unit with an integrated data handling and display capability.

Thermoluminescent Dosimeter Standards

The task of developing production control standards for the Navy's CaF: Mn thermoluminescent dosimeters was assigned to NRDL as a companion to the DT-60 production control program. The standards developed consist of CaF: Mn dosimeter powder mixed with radioactive $BaCO_3$ containing C^{14} which bombards the phosphor with β-rays thereby producing fluorescence. These light sources, sealed in appropriately shaped glass containers, duplicate the light emitted from the dosimeters both in spectrum and geometry. A four-turret comparator was also developed which, in addition to calibrating the standards, permits measuring the emission spectrum, checking uniformity and stability of emission, and allows a direct comparison to thermoluminescent dosimeters.

The Application of Reliability Analysis to Radiacs

Continuous operation of 100 new, factory-packaged AN/PDR-27J radiacs at approximately 25^0C and a relative humidity in the range between 30 per cent and 60 per cent for 1000 hours demonstrated that some 90 per cent of failures occurred in the first 100 hours. Failure rate as a function of running time under these conditions indicated that, for radiacs of the complexity level of these radiacs, run-in time at the factory should not be less than 80 hours, this time being a good compromise between cost and results. The results of these experiments have appeared in a recent contract specification from the Bureau of Ships which calls for a factory run-in of 85 hours on new radiac instruments supplied under that contract.

PROTECTIVE MEASURES AGAINST NUCLEAR WEAPONS EFFECTS

Development of protective systems during and post-attack is one of the most tangible products of the Laboratory and derives directly from the acquisition of knowledge discussed in the earlier sections of this chapter.

As new information is obtained, these protective measures and doctrines are revised. The following describes the major efforts in this regard during the past year.

1. Development of Standoff Doctrine for Nuclear-Depth-Charge Delivery

A 1962 study pertaining to naval operations was the development of stand-off doctrine for the delivery of nuclear depth charges. This study includes analyses of the significant underwater-shock and radiological effects of nuclear depth charges, with procedures for the tactical display of the significant effects of nuclear depth charges. Assistance was provided OPTEVFOR in defining the significant effects of nuclear depth charges for use in developing the OPTEVFOR employment doctrine.

2. Vulnerability of the CVA 67 to Nuclear Attack

A study was completed on the vulnerability of the CVA 67 to nuclear attack, and recommendations were made to improve the carrier's operational capability in nuclear-warfare environment. A report was prepared that summarizes the significant weapon effects of air and underwater bursts for a range of weapon yields, and interrelates the carrier's radiation protection characteristics and the radiological countermeasures that it can take to maintain its operational capability.

3. Improved Doctrine for Ship and Fleet Nuclear Warfare Defense

The continuing analyses of procedures for ship and fleet nuclear warfare defense resulted in the further development of doctrine to improve shipboard defensive operations. This proposed doctrine updates the nuclear warfare defense material in the naval warfare publications NWP 50 (A), Shipboard Procedures, and NWIP 50-1, Battle Control. The doctrine describes the significant consequences of nuclear-weapon effects to naval ships and ship operations, and recommends procedures for collecting, evaluating, displaying, and disseminating data on radiological effects, and for controlling radiation hazards in fleet operations.

4. Radiological Protective Construction

In the event of a nuclear attack, the threat from radioactive fallout could overshadow the more immediate weapon effects. Because of its far-reaching and long-lived characteristics, fallout from a single megaton-range detonation could make thousands of square miles inaccessible for extended periods of time. A modified form of protective construction was offered as a defense against fallout and its effects in the report USNRDL-467, "Radiological Protective Construction" published in June. A number

of protective principles are presented which can be either incorporated into the design of new buildings or applied to existing buildings to:

a. Improve the inherent shelter effectiveness of structures,

b. Minimize the deposition and retention of fallout and

c. Facilitate the removal of fallout.

5. NRDL Shelter Program

The NRDL shelter program, using the Camp Parks shelter, was completed. Two reports were issued: "Design Modifications and 1962 Cost Analysis for a Standardized Series of Fallout Shelters" and "Preliminary Report on the Shelter Occupancy Test of 4-6 November 1960." The latter is on the so-called family occupancy test; a film summary on this test was also completed to be used for training purposes. In addition, many briefings on the NRDL shelter program were held, at the Laboratory and at Camp Parks, for the benefit of national, state, and local civil defense personnel; state legislative committees; local school personnel; and potential shelter contractors. One overnight shelter-occupancy test was held as a joint effort of NRDL and the Western Instructor Training Center of the Office of Civil Defense. The shelter was made available to this Center on several occasions for 1-day occupancy tests in connection with their shelter management course.

6. Dose Rate Distribution from Gamma-Ray Scattered Through Iron and Aluminum

To provide adequate protective measures the supply of knowledge of fundamental shielding information must be increased. Research on the nature of gamma ray penetration through iron and aluminum was continued during 1962. These materials are of particular interest in ship shielding calculations because of the aluminum super structure and steel hauls.

Experiments in dose rates through various thickness of materials at various angles using different radiation sources showed that the effect on the dose rate correlated well with theoretical (Monte Carlo) calculations.

7. Gamma-Ray Shielding Properties of Plane Steel Slabs in Simple Point-Source to Slab to Detector Geometries

The complexity of geometric factors introduced into the shielding calculations by the configuration of shipboard or other practicable applications requires detailed knowledge of the so called buildup factors for comparing thick and thin slabs and their relative position with respect to the

source. Significant findings were made in the measurements which will influence calculation methods...for more complicated although simplified, geometry was used.

RECOVERY PROCEDURES

In case of nuclear weapon detonations or other types of uncontrolled nuclear energy releases it will be necessary to know in advance what procedures are needed to recover installations that must be used again, and how to determine whether a particular installation is worth expending time and effort in recovery processes. NRDL personnel worked on a number of projects of this specific type during the year. Again, as in the discussion of protective measures, it may become necessary to revise doctrine and procedures developed in these projects as new and more useful information becomes available.

Recovery of Naval Shipyards Following Massive Nuclear Attack

A comprehensive investigation of the effect on naval shipyards of a massive nuclear attack on the continental United States using specific shipyards on both coasts for reference is nearing completion. This study takes into account all the effects of a nuclear detonation: initial (neutron and gamma) radiation, thermal radiation, air blast, underwater shock, and residual (fallout) radiation. Resources of a naval shipyard (San Francisco Naval Shipyard was used in the pilot study) are catalogued in detail, first as to their importance in the mission of the shipyard, second, as to their vulnerability to the various effects. These resources include structures, equipment, and personnel. All weapon-effects and resources information are set up as input data for a computer program which then, for any detonation, computes not only the state of the shipyard after the detonation, but also the time of availability of the resources for vital mission operations after decontamination and repair have been done by shipyard personnel. Computations are made for two situations: (1) Sufficient warning has been received to put personnel into the best available shelters; and (2) No warning has been received. The program has already been run for a number of single-weapon attacks, including surface and air bursts. Detonation conditions have been selected to give effects ranging from light-to-moderate damage to massive destruction (high probability of knocking out all the drydocks and all structures and equipment, and leaving essentially no survivors). Even the limited number of runs has shown the importance of pre-attack preparation including (1) disaster control plans designed to take advantage of existing shelter with minimal warning; (2) provision of adequate shelter against fallout radiation; and (3) stockpiling of decontamination and repair

equipment in protected spaces. Briefings on the program and on these results have been presented at the Bureau of Ships and at the Bureau of Yards and Docks.

Radiological Recovery Following Accidents to Shore-Based Naval Reactors

A detailed plan was developed for the radiological recovery of land-based naval reactors following major-release accidents. This plan describes the types of radiation hazard to be encountered and the general nature of the emergency and recovery measures. A general description and a block diagram of the recovery plan are included. The time sequence of steps involving automatic actions and personnel actions are also given in the plan along with a description of a suggested emergency communications system. This plan was specifically designed for BUDOCKS type of advanced base reactors.

Recovery of Oil Refineries Following Fallout Contamination

A study of the effect of fallout on the oil refinery industry of the United States was completed. The objective was to estimate the effort in man-days and time required to recover various percentages of normal operating capacity for refineries of varying size and complexity. It was assumed that:

1. A refinery is shut down immediately, or soon after an alert is sounded;

2. Refinery personnel go to adequate shelter and stay there until it is safe to start decontamination and repair operations; and

3. 75 per cent of the refinery personnel are available for these operations. It was found that damage due to too rapid a shutdown was, in many situations, the most significant factor in determining how soon a refinery would be operating again, and that in some cases the time required for the repair of shutdown damage was almost 100 times as great as the time required for decontamination. Therefore, careful planning of emergency shutdown operations could be a major factor in the ultimate availability of oil refineries after nuclear attack.

Land Target Complex Studies

Facilities escaping physical damage from a nuclear attack still may have to cope with hazardous amounts of fallout. The survival of personnel and the resumption of vital missions could depend upon the timely removal of the fallout deposits. The safe performance of such a removal effort is

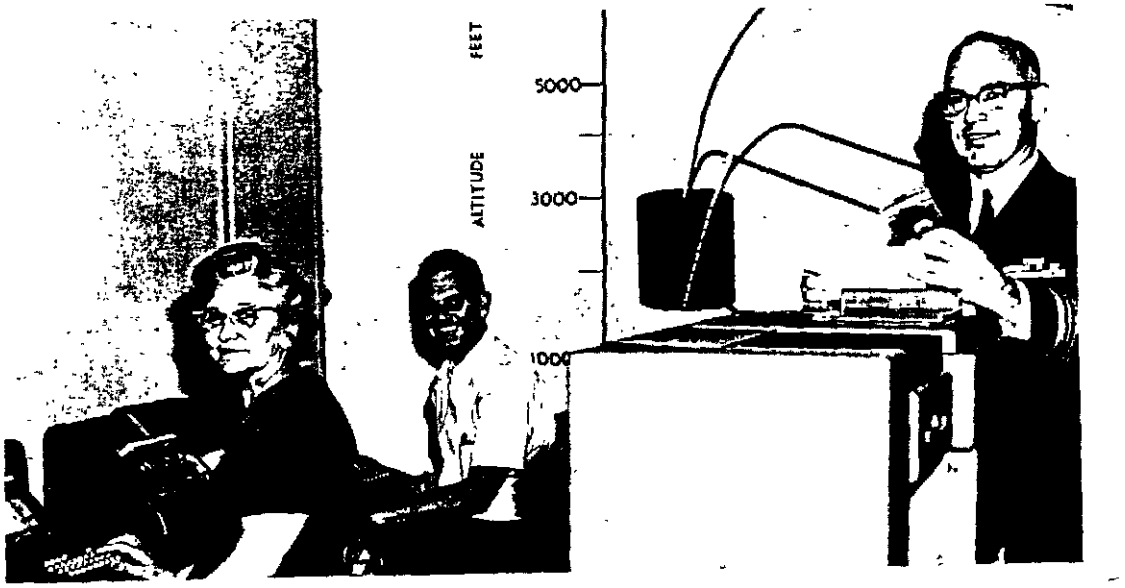
possible only if a detailed radiological recovery plan exists before attack. The results of two experiments to obtain operational data on the radiological recovery of a land target complex, together with a suitable recovery plan were presented in the report USNRDL-TR-570. The results show that, within prescribed dose limits, pre-attack planning of a radiological recovery operation is not only feasible but strongly recommended.

Fleet Radiological Countermeasures

Studies to evaluate and improve tactical decontamination procedures and techniques continued at the Camp Parks test facility. Some 1300 painted steel plates were contaminated simultaneously in a 40 ft diameter contamination chamber and various decontamination methods were investigated. The contaminant is in the form of droplets, simulating the fallout resulting from a megaton-range nuclear explosion at the sea surface. Fifteen of the most important gamma-emitting fission products are being studied singly. Experiments completed thus far include four of these.

SPEEDS UP OPERATION -- Preparation for mechanized ordering of Ready Supply Stores material was commenced in March 1962 and completed in May. Card formats are programmed for Navstrip DD1348 Stub Requisition, using six cards to a master packet with a total of 33,000 cards. At left, Jeannette Bedford prepares replenishment stub requisitions on an Electronic Typewriter. Completely automatic, 85 stubs per hour are prepared, opposed to 55 daily when typed manually. Prior to programming to the "632", the preparation of stubs was a critical function requiring two clerks both typing 4 to 5 hours daily. Backlogs occurred frequently. Replenishments can now be maintained on a strictly current basis requiring only one person 1-1 1/2 hours per day.

A.D.P CONVERSION -- The inventory control functions of the Ready Supply Store were converted to an automatic data processing system during 1962. Stock record cards for the stores 5,500 items were programmed for the computer peripheral equipment. The cards are updated weekly to reflect issues, receipts, price changes, and adjustments. Transaction and inventory registers are also prepared weekly to provide current information, i.e., balances on hand, usage, replenishment, and insurance items. Through A.D.P., greater speed, accuracy and flexibility have been attained, permitting more and better service. (Below) -- LCDR J. C. Bartlett, Head, Logistics Support Div., reviews Master Balance Cards preparatory to their being merged with transaction cards on the collator. Mrs. Bedford key punches cards from source documents and Ambrose Robinson machine verifies for accuracy.



CHAPTER III -- PUBLICATIONS

REPORTS AND MEMORANDA

The following types and number of publications were issued in 1962:

U. S. Naval Radiological Defense Laboratory Report (Formal)	5
Technical Reports (USNRDL-TR)	59
Technical Memoranda (TM)	4
Progress Reports (P)	5
Evaluation Reports (ER)	2
Reviews and Lectures (R and L)	2
Total	77

PUBLICATION IN THE OPEN LITERATURE

Forty-seven papers and articles by NRDL authors were published in over 25 journals during 1962.

MISCELLANEOUS PUBLICATION

"RADIATION EFFECTS ON ORGANIC MATERIALS" -- Ray S. Alger, Head, Radiation Effects Branch, is the author of the chapter on "Dielectric Fluids" in the above named book. Prepared under the auspices of the AEC's Division of Technical Information, this is the first book covering the alterations induced by nuclear radiation in properties of a wide range of organic materials.

NRDL CO-AUTHORS -- During the past year and a half, the Atomic Energy Commission has sponsored the printing of a series of 60 monographs on "The Radiochemistry of the Elements." Dr. N. E. Ballou, Head, Nuclear Chemistry Branch, and Edith Scadden of the same Branch are co-authors of one of these monographs, "The Radiochemistry of Molybdenum (NAS-NS-3009).

INVITED CONTRIBUTOR -- Dr. R. W. Brauer, Head, Pharmacology Branch, was an invited contributor to the book "Man and His Environment," specifically the chapter titled "Irreversible Effects of Environmental Stress - Ageing and Environment," O. Edholm, editor, 1962; and was an invited contributor, along with former NRDLER, CAPT A. R. Behnke, USN (Ret.), to the book, "Harrison's Principles of Internal Medicine," 4th edition, specifically chapter titled "Hypothermia and Cold Injury," 1962.

PATENTS

Seven patents were issued: (1) E. J. Wesley - Radiac Alarm Dosimeter, Patent No. 3,019,339; (2) E. J. Wesley - Recycling Radiation Rate Meter, Patent No. 3,050,625; (3) E. C. Evans III and V. A. French - Aerosol Sampler, Patent No.3,035, 445; (4) C. P. Butler - Radiation Calorimeter, Patent No. 3,034,355; (5) W. J. Heiman - Gun Barrel with Layer of Radioactive Material, Patent No.3,034,244; (6) R. A. Nyberg and T. L. Sheridan - Transistor Blocking Oscillator Power Supply, Patent No. 3,023,375; and (7) L. H. Gevantman and J. F. Pestaner - Method and Means of Measuring Radiation Tri-Directionally, Patent No. 3,031,575. Dr. Gevantman's and Mr. Pestaner's patent was among 65 recently made available for public use by the U. S. Atomic Energy Commission, 59 of them owned by the Government and held by the Commission and six held by other Government agencies for licensing.

During the year three patent disclosures were authorized for filing; seven were submitted to Patent Counsel; and eight were under preparation for submission.

CHAPTER IV

AWARDS -- COMMENDATIONS -- HONORS

SECNAV AWARD FOR $5,000

Dr. Edward L. Alpen, Head of the Biological and Medical Sciences Division, received the Secretary of the Navy's Award for Distinguished Achievement in Science which carried with it a $5,000 monetary award. This is the second time this award has ever been granted. It was based on Dr. Alpen's outstanding pioneering efforts in the field of biological effects of radiation.

RADM C. A. Curtze, Commander, San Francisco Naval Shipyard, made the presentation for the Chief of the Bureau of Ships on behalf of the Secretary of the Navy. The citation said that Dr. Alpen "has brought to bear a wide knowledge of ionizing and other radiations. He has represented bioscience with distinction in many places here and abroad. By his exhaustive studies of energy dependence of biological effects and clarification of mixed radiations and their effectiveness, and the culmination of a new doctrine for radiological hazard evaluation he has accomplished scientific achievements of extraordinary importance, of value to the Nation and to the world."

In case of nuclear attack, this information would have important civil defense implications; it is of immediate concern to the Navy whose very future depends upon its ability to operate effectively in a "nuclear environment." Dr. Alpen has shown how best to employ countermeasures against the contamination of ships and their personnel; how much of several kinds of ionizing radiation can be tolerated; and how best to offset their effects.

Attended by Dr. Edward Teller, RADM E. J. Fahy, Commander, Mare Island Naval Shipyard, Laboratory members, and a number of civic leaders, University professors and other friends, the ceremony was held in the NRDL Auditorium on 27 June 1962. It was followed by a brief reception in the cafeteria.

CITATION AND CHECK! -- as Dr. Alpen looks at his citation for the Secretary of the Navy's Award for Distinguished Achievement in Science, RADM Curtze holds the award check.

AT THE RECEPTION -- Dr. Alpen cuts a piece of the cake decorated in his honor. Beside him are his two daughters, Jeannette, 6, and Angela, 10, and Dr. Ralph W. Brauer, Head of the Pharmacology Branch of the Bio-Med Division. Presiding at the table is Helen Power, Chairman of "WE" (Women Employees of NRDL). In the background (from left): Mrs. and CAPT A. R. Behnke, USN (Ret.) (former NRDLER); Leonard Cole, Head of the Bio-Med's Experimental Pathology Branch; and Mrs. Alpen.

NRDL GOLD AND SILVER AWARDS TO ADAMS; ZAGORITES

The first annual Gold Award for Scientific Achievement went to Charles E. Adams, Chemist (Radiological) in the Physical Chemistry Branch, Chem Tech Division; and the first annual Silver Award was earned by Harry A. Zagorites, Electronic Engineer who heads the Instrument Branch's Systems Engineering Program. The presentations were made by the Scientific Director, Dr. E. P. Cooper, at a ceremony in the Auditorium on 5 June 1962.

Mr. Adams contributed toward the solution of the "Boron Oxide Anomaly" problem by applying the results of high temperature research carried out under his direction.

Mr. Zagorites showed that transit radiation could affect the reliability of transistorized electronic equipment. He has devised methods for overcoming this problem in some of the situations of concern in a gamma-intensity-time recording system.

Under the Superior Accomplishment Awards program, the accomplishments upon which Adams' and Zagorites' work were based for the Gold and Silver Medals were also recognized by monetary awards.

MERITORIOUS CIVILIAN SERVICE AWARD FOR SOULE

Richard R. Soule, Radiological Effects Branch, Chem Tech Division, received the Meritorious Civilian Service Award for his contributions in achieving the objectives of the HYDRA II-A program for scientific investigation of underwater explosive effects in the capacity of Project Officer. Along with this honorary award (the Navy's third highest), Mr. Soule also was presented a Superior Achievement Award by the Commanding Officer and Director, CAPT E. B. Roth, on 1 February 1962.

The award letter cited, "The significance of the results achieved are unprecedented and profound in the field of hydrodynamics. In addition, the benefits are very widespread affecting several components of the Navy Department's research as well as research of non-Navy and non-government activities. His technical competence was clearly evident in his grasp of all aspects of the multiple-discipline operation. Mr. Soule showed superior administrative capabilities as Project Officer...the success or failure of each detonation, the safety of personnel, the acquisition of valid technical data, the morale of all personnel...were his responsibility alone and many extremely difficult decisions had to be made with no one's help..."

ARMY COMMENDATION MEDAL

LCDR Gordon W. Werner, MSC, USN, Head of the Radiobiological Assay Section, was awarded the Army Commendation Medal. Only about 10 are known to have been received by Navy personnel. LCDR Werner was cited for "outstanding service from 1 May 1958 to 6 November 1961 as Bio-Chemist and Medical Effects ABC Warfare Instructor, U. S. Naval Unit, U. S. Army Chemical Corps School (Fort McClellan, Ala.). During this period LCDR Werner, through his experience and professional competence was called upon to present to troops of the U. S. Army Chemical Corps Training Command a continuing program of personal hygiene. Showing outstanding initiative and devotion to duty, he developed unique and highly effective teaching techniques and was responsible for coordinating the efforts of the Naval Unit for development of the Alpha Field on this installation. He participated in and was an active member of the military and civilian community which fostered good public relations and encouraged a wholesome social atmosphere." The citation was signed by the Secretary of the Army, Elvis J. Stahr, Jr., and the Chief Chemical Officer, Marshall Stubbs, Major General, USA.

FROM FIRST CLASS TO ENSIGN

On 1 October 1962, HM1 Joe Winningham, Military Personnel Office, slipped out of his blues and into an officer's uniform after being sworn in as an Ensign, MSC, USN, by CAPT Roth. He was selected as a result of an annual servicewide test open to First Class and Chief Hospital Corpsmen and Dental Technicians who were recommended. Ensign Winningham was transferred from NRDL soon afterwards because there was no appropriate billet here for him.

THANKS FOR APPLYING "GOOD NEIGHBOR" POLICY

Following a pier fire at the San Francisco Naval Shipyard on 9 November, RADM C. A. Curtze, Commander, wrote to CAPT Roth: "Please accept the deep appreciation of the Shipyard for your immediate and effective response to the emergency posed by the fire at Pier 59. The Radiological Laboratory's 'Good Neighbor' policy in furnishing medical personnel certainly was in the highest tradition of the Naval Service. This prompt response indicates an excellent degree of readiness and training of the personnel under your command. The attitude of all personnel was that of the highest degree of willing cooperation and courteous efficiency..."

GOLD & SILVER AWARDS -- Charles E. Adams receives first annual Gold Award for Scientific Achievement from Dr. E. P. Cooper, Scientific Director. Looking on are the Silver Medal winner, Harry Zagorites, and CAPT Roth.

CONGRATULATIONS, DAD -- Adams with his family, 11-year old twins, Steve and Tom; David, 14, and wife, Nancy. Invited to the stage by Dr. Cooper during the ceremony, young Steve presented his father with a scroll signed by all of his 5th grade classmates and teacher at Hillside Grammar School, Berkeley.

PROUD MOMENT -- Plankowner Richard R. Soule (at NRDL since 1948) receives the Meritorious Civilian Service Award from CAPT Roth.

ARMY RECOGNIZES NAVY -- LCDR Gordon W. Werner is pinned with the Army Commendation Medal by CAPT Roth. Only about 10 ACMs have ever been received by Navy personnel, according to LCDR Werner, who was cited for outstanding service at Fort McClellan, Ala.

GENERAL AWARDS

Fifty-three Superior Accomplishment Cash Awards totaling $11,550 were presented to 63 civilians (five of the total were group awards). Sixteen received Outstanding Performance ratings for the year.

Of the 76 Beneficial Suggestions received, 31 were adopted with a total cash award of $2,340. (27 were intangible and four were for tangible benefits. Twelve Patent Awards totaled $1,250.

The Laboratory received the Secretary of the Navy Award for Achievement in Accident Prevention and four Safe Driving pins were earned.

Twenty-two 20-year service pins were presented. Five military men received Good Conduct medals.

An attractive pin, gold in color, was designed by the Graphic Development Branch to be presented to all Laboratory civilians who retire under the Civil Service Retirement system. Former NRDL employees who had retired before the pin was available for presentation were each sent one. During 1962 twenty-five of these Service Pins were issued.

MISCELLANEOUS HONORS

Upon nomination by NRDL and BUSHIPS, Dr. Mathew G. Gibbons, Physicist (Nuclear Physics), Military Evaluations Division, was selected by the Institute of Naval Studies, Naval War College, Newport, R.I., to serve for a period of up to one year, beginning in July 1962, as a Naval Research Assistant.

Dr. N. Ballou, Head, Nuclear Chemistry Branch, a member of the Subcommittee on Radiochemistry of the National Academy of Science for about two years, was appointed Chairman. This appointment automatically makes Dr. Ballou a member of the Committee on Nuclear Science.

LCDR W. A. Foley, (MC) USNR, Head, Pathology Service, was certified and became a diplomate of the American Board of Pathology.

George R. Hunt, Head Animal Keeper, was qualified by the Certifying Board of the Animal Care Panel.

Dr. R. R. Newell, Medical Consultant, was made a member of the National Council on Radiation Protection and Measurements, as are former NRDLERS Dr. P. C. Tompkins, Deputy Director of Radiation Standards for the AEC in Washington, D. C., and Dr. Victor Bond, Head of the Medical Department at Brookhaven.

Dr. B. G. Crouch, Cellular Radiobiology Branch, and Dr. E. L. Alpen, Head, Bio-Med Division, were invited into the Royal Society of Medicine in England.

CHAPTER V

SEMINARS -- SYMPOSIA -- CONFERENCES

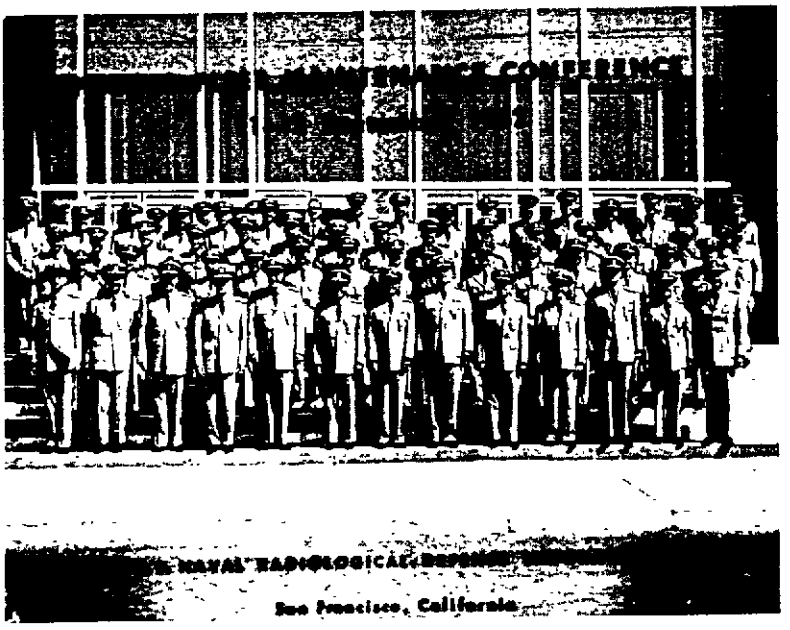
MEETINGS AT NRDL

In 1962 as in prior years NRDL was host to a number of important conferences:

6TH NAVY SCIENCE SYMPOSIUM -- Sponsored by the Office of Naval Research, Washington, D. C., the 6th Navy Science Symposium, held on 2-3 May, was attended by about 350 Navy scientists. The theme of the Symposium was "Weapons and Weapons Effects." All sessions except that of the first morning were classified. The participants examined the Navy's latest research directed toward understanding the phenomena resulting from all types of explosions in all environments, and toward predicting the response of materials, vehicles, weapons systems, and personnel to these phenomena.

FLEET MAINTENANCE -- Many high-ranking officers were among the attendees (pictures on the next page) at the Fleet Maintenance Conference 11-12 September. This conference is held annually to provide to representatives of the U. S. Pacific Fleet, the various service and repair activities located in or continguous to the Pacific Ocean Area, and the several interested Bureaus and offices of the Navy Department in Washington a regularly planned opportunity to exchange information and viewpoints and to discuss common problems of Fleet maintenance in order to further material readiness in the U. S. Pacific Fleet.

USNRDL-DASA FALLOUT SYMPOSIUM -- During the week of 17-21 September, the Laboratory acted as host to over 100 contributors and users interested in the development of fallout prediction models and systems and representing about 45 universities, private firms, and government agencies. Called the USNRDL-DASA Fallout Symposium, the classified meeting was the third of a series; previous meetings were held at AFSWP Headquarters in 1955 and at RAND Corporation in 1957. The purpose of the meeting was to present, discuss, and compare the theoretical bases and uses of existing major prediction systems. To this end, descriptions of various models and systems, along with a standard set of "homework problems" on each model or



6TH NAVY SCIENCE SYMPOSIUM BANQUET --(Top left) Dr. J. H. Wakelin, Jr., Assistant Secretary of the Navy (R&D), discusses the Robert Dexter Conrad Award. In past years it has been presented at the ONR Symposium. This year it was presented on 8 March in Washington, D. C. before the recipient VADM J. T. Hayward, USN, left for a new assignment as Commander, Carrier Division Two. (Top right) VADM W. F. Raborn, USN, Deputy Chief of Naval Operations (Development), delivers the main address.

system were mailed to prospective participants in advance of the meeting, and available answers were then discussed at the meeting. The Proceedings are being published.

JANA CONFERENCE -- The 7th JANA (Joint Army, Navy and Air Force) Research and Development conference (sponsored by the Office of Naval Research) was convened on 22-24 October with about 250 attending to exchange information on elastomers. Dr. L. H. Gevantman, Head, Chem Tech Division, is a member of the Planning Committee, and Mr. R. P. Nicolson, local coordinator, is on the Executive Committee of the JANA Conference. This group meets at approximately two year intervals to reexamine intervening scientific and technical progress in the field and appraise future critical weapons and systems requirements.

OTHER -- 6th meeting of the Shielding Panel of the Weapons Effects Board of the Defense Atomic Support Agency; Advisory Committee on Phenomena of Underwater Explosions (APEX); Committee on Fire Research of the National Academy of Sciences, National Research Council; Navy Senior Scientists' Council; Inter-Laboratory Committee of Editors and Publishers; Oceanography Conference; Inter-Laboratory Committee on Facilities; and Radiac Committee of the Armed Forces Radiobiology Research Institute (AFRRI).

In October the Scientific Director presented a Colloquium jointly with the NRDL Sigma Xi Club. The speaker was Dr. Herbert L. Mason, Professor of Botany and Director of the Herbarium of California; his subject was "An Analysis of the Taxonomic System in Biology." Earlier in the year Sigma Xi invited all Lab personnel to attend its 2nd annual Spring lecture, presented by an international authority on the treatment of radiation sickness, Dr. D. W. van Bekkum, Director of the Radiobiological Institute of the National Health Research Council for The Netherlands. He spoke on "Bone Marrow Transplantation, a Double-Edged Sword." Dr. Claude R. Schwob, Consultant to the Scientific Director, was the 1962 president of the NRDL Sigma Xi Club.

MEETINGS ELSEWHERE

President Kennedy invited Dr. R. R. Newell, Medical Consultant, to attend the President's Conference on Occupational Safety in Washington, D.C. in March. In August Governor Brown at his Los Angeles office heard a report from his Radiological Defense Advisory Committee, which includes Dr. Newell and Dr. E. P. Cooper, Scientific Director. CAPT E. B. Roth,

Commanding Officer and Director, and Dr. Richard Cole, Head, Countermeasures Evaluation Branch, on 29 January testified on the technical details of shelters on invitation from the State of California Joint Interim Legislative Committee. This Committee was meeting in San Francisco to evaluate the feasibility of some form of shelter facility in connection with our educational system.

Since exchange of ideas is of vital importance, again in 1962 members of the Laboratory staff were active participants in arranging and speaking at meetings throughout the world. Those attended outside the United States included the Tripartite Conference (Radiological Defense Discussion Group), Porton, England; Tripartite Conference on Ship Defense, Ottawa, Canada; 2nd International Congress of Radiation Research, Harrogate, England (two of nine NRDLERS attending went on awards from the National Academy of Sciences); 1st International Symposium on Bone Marrow Therapy and Clinical Protection in Irradiated Primates, Radiobiological Institute of the National Research Health Council of The Netherlands; International Congress of Hematology, Mexico City; 4th International Symposium on Space Technology and Science, Tokyo, Japan; International Congress of Microbiology, Montreal, Canada; International Symposium on Temperature Acclimation, Amsterdam, Netherlands; International Congress of Physiological Sciences, Leiden, Netherlands; Nuclear Chemistry Discussions, Oxford University, England; and International Atomic Energy Agency Symposium on Neutron Detection, Dosimetry and Standardization, Harwell, England.

CHAPTER VI -- TRAINING

One hundred and seventy-three employees attended 50 courses in technical and management subjects in 1962. Twenty employees initiated or continued degree programs in Bay Area universities with Laboratory support. R. W. Holloway, Pharmacology Branch, was a full-time graduate student at the University of California for a year. E. S. Shapiro, Hazard Evaluation Branch, took a six months advanced mathematics course at the University of Pittsburgh and received his Ph. D. in June 1962.

Two senior investigators participated in the Army conducted Personnel Management Conferences for Executives in Berkeley and another in a Leadership Laboratory for Research and Development Supervisors in Santa Barbara. The Scientific Director attended a Conference on Science and Democracy at the Center for the Study of Democratic Institutions in Santa Barbara.

The Cooperative Education Program continued to be phased out. Only four trainees remained at the end of the year. During 1962 three Co-Op students graduated and joined our permanent staff.

The Summer Employment Program (which started in 1955) included 67 employees this year. Over 400 applications for summer work were received from individuals in educational institutions in 41 states. The selected group included seven faculty members, 37 graduate students and 22 undergraduates. They represented 30 educational institutions in all parts of the United States. Of this group, 22 had worked at NRDL previously.

A significant development during 1962 was the establishment of the University of California-NRDL Extension Program. Under this program classes in "Advanced Mathematics for Scientists and Engineers" and "Introduction to Nuclear and Atomic Physics" were held during the Spring 1962 semester; and classes in "Introduction to Quantum Mechanics" and "Intermediate Nuclear and Atomic Physics" in the Fall semester. These classes were held at the Laboratory after working hours. Thus far the classes have been taught by staff members accredited to the U. C. faculty.

Two In-House Training Programs were offered this year during working hours: Transmission of Data by Cable; and Technical Report Writing.

Enlisted personnel were given an average of 13 hours per man each month in many subjects to help broaden their education and to help them advance in the Service. Of the 40 enlisted personnel on board, nine were advanced in rate. Two re-enlisted during the year. There are 28 officers on board and five were advanced in rank in 1962. One transferred from the Reserve to the regular Army.

SCIENTISTS-IN-RESIDENCE -- The Program, started in 1961 with the one-year appointment of Dr. Olivier Heroux (top left), Associate Research Officer at the National Research Council, Ottawa, Canada, was expanded this year to include four Scientists-in-Residence. (Dr. Heroux returned to Canada in October 1962.) The other three were Dr. Michael John Ashwood-Smith (top right), a Physiologist on a year's leave of absence from the National Institute for Medical Research, London, England, who joined the staff of the Biological and Medical Sciences Division's Cellular Radiobiology Branch on 4 October; Dr. C.E. Mandeville (not pictured), Professor of Physics at Kansas State University, who worked in the Nucleonics Division's Nuclear Radiation Physics Branch for three months; and Dr. Katsuji Nakata (seated above), who was here for five months from the Osaka Medical College, Japan, where he is Associate Professor and Pathologist, Department of Pathology. At NRDL he worked on a research project in Bio-Med's Pharmacology Branch with Mr. Roy J. Holloway (pictured with him).

CHAPTER VII -- VISITORS

Distinguished scientists and military men from a number of countries, high ranking officers from the three branches of the U. S. Armed Forces, lawyers attending the American Bar Association Convention in San Francisco, scientists probing aerospace problems, soil experts, professors, and many student groups ranging from junior high school level through specialized postgraduate college level were among the over 10,000 persons visiting the Laboratory in 1962.

Among the many important visitors from this country were Dr. Edward Teller, U. C., Dr. Eugene Wigner, Princeton University, and Dr. Willard Libby, UCLA -- here for Civil Defense-oriented presentations; Dr. Howard White, Assistant to the Assistant Secretary of the Navy for Research and Development; Brigadier General W. T. Ryder, Director of Special Weapons, Office of Chief of Research and Development, Department of the Army; Brigadier General F. J. Delmore, Commanding General USA Chemical Corps, Research and Development Command: Colonel J. C. Prentice, Chemical Officer, Sixth U. S. Army; four members of the Task 20 Panel of the Institute for Defense Analysis -- Dr. Herbert Pollack, Associate Professor Clinical Medicine, PG Medical School, New York University; Dr. Eugene P. Cronkite, Head, Division of Experimental Pathology, Medical Research Center, Brookhaven National Laboratory; Dr. C. N. H. Long, Professor and Chairman, Department of Physiology, Yale University; and Dr. Henry B. Steinbach, Professor and Chairman, Department of Zoology, University of Chicago; two soil experts available for consultation, James R. Burn, Assistant Chief, Military Geology Branch, U. S. Geological Survey, Washington, D. C., and John Rourke, Assistant Chief, World Soil Map, Beltsville, Md.; Colonel T. A. Rafferty, General Staff, USA, Head, Infantry Weapons and Field Equipment Division, Office of the Deputy Chief of Staff for Material Developments, U. S. Continental Army Command; RADM George P. Koch, USN, Prospective Commander, Fleet Air Wings, U. S. Atlantic Fleet; RADM E. E. Colestock, USN, Director, Institute of Naval Studies, Naval War College, Newport, R. I.; RADM H. L. Reiter, Jr., USN, Senior Naval Member, Weapons Systems Evaluation Group under the Director of Defense Research and Engineering; Professor Tomonori Hyodo, Fellow of the MIT School for Advanced Study; CAPT D. D. Campbell, Code 320 BUSHIPS (former NRDL Senior Program Officer); Dr. Carl Lamanna, Deputy Chief and Scientific Advisor, Life Science Division, Office of the Chief of R and D, Army; Dr. W. Jost, Department of Chemistry, U. C.; RADM R. W. Taylor, DC, USN, 12ND Dental Officer; and RADM R. S. Benson, COMSUBPAC. Several of these visitors presented seminars.

A few of the student groups included attendees at the San Francisco State College Peace Corps Project; 23 teachers in the National Science Foundation Research Program at U. C. (second year to visit NRDL); Dr. Nello Pace's Graduate Seminar from the U. C. Department of Physiology; NROS-12-1, ABC Warfare Defense; Restricted Weapons Division, Naval Schools Command, T.I.; Nuclear Engineering (Effects), PG School Monterey; NROTC Midshipmen participating in Eastern Pacific Midshipmen Cruise; Junior and Senior High School first, second, third, and fourth place winners of the San Francisco Bay Area Science Fair, accompanied by members of Naval Reserve Public Relations Company 12-1.

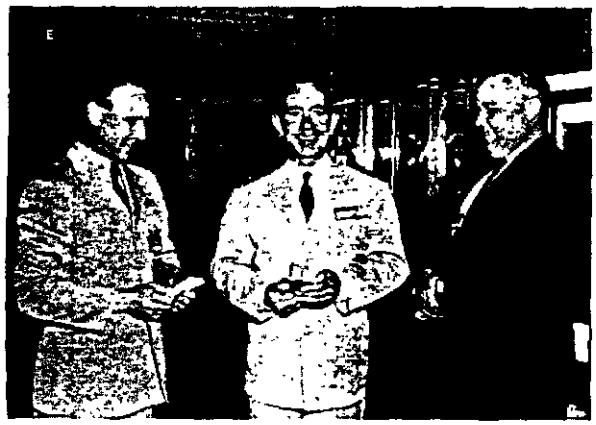
Senior Friendly Allied Naval Officers came from Burma, Chile, Denmark, Ecuador, Japan, Peru, and Viet Nam. Other countries represented were: AUSTRALIA -- H. A. Luke, Surgeon Lieutenant Consultant to the Royal Australian Navy and Director, Diagnostic Radiology, Alfred Hospital, Victoria. BELGIUM -- Dr. A. Van Tiggelen, University of Louvain -- Research sponsored by the U. S. Army, Europe Research Office. BRAZIL -- Fleet Admiral Ary dos Santos Rongel, Chief of the Naval General Staff of Brazil (equivalent to the U. S. Chief of Naval Operations) and staff; and later VADM Waldyr C. Pires, MC, Surgeon General of the Brazilian Navy and staff. CANADA -- Commodore J. C. O'Brien, Royal Canadian Navy, Navy Attache to Washington, accompanied by Colonel Wilbur Berry, Chief, Department of Medicine, Letterman General Hospital, and Major J. D. Wallace, Chief, Education and Training, LGH. ENGLAND -- Director General of the British Army Medical Services, Lieutenant General H. E. Knott; 20 officers from the British Cruiser HMS Belfast; Air Commander Adam Muir of the British Defense Staff (RAF Staff); Colonel Leonard W. Jubb, RA, British War Office; Ronald Holmes, Defense Research Staff, British Embassy. ETHIOPIA -- Defacto CNO of the Ethiopian Navy, CDR Alexander Desta, grandson of Emporer Haile Sellassi I. FRANCE -- RADM Jean Guerin, French Naval Attache, Washington, D.C.; Dr. Pierre Carlo, Wyeth Laboratory, Paris; Dr. Jean Pierre Adloff, Strasbourg; and Surgeon General of the French Navy, VADM E. C. M. LeBreton, and CAPT P. H. Bonnel, MC, FN. GERMANY -- CDR Ernst-Wolfgang Rave and Paul Kramer, Ministryof Defense, Federal Republic of Germany; Dr. Wolfgang Strathmon, Federal Republic of Germany; Dr. Wolfgang Hink, I. Physikalisches Institut, Freie Universitat, Berlin; and Brigadier General K. Braunig, Head of Research, Development and Engineering, Republic of Germany, and party. He was also here in 1960. INDIA -- K. Gopal Reddy, graduate student of the University of Hawaii who received a summer Fellowship at the Scripps Institute of Oceanography. ITALY -- Dr. Gino Dorio, Euratom Laboratories, Rome. JAPAN-- Dr. Shujiro Okamoto, Professor of Radiology, Tokyo Medical Center. PAKISTAN -- Tariq Mustafa, Atomic Energy Commission. SWEDEN -- Major S. G. P. Wikland, Chief of Staff, Inspection Office of Maintenance and Supply Troops, Army Staff, Stockholm; Dr. E. E. Schildt, Chief, Radiophysiological Section, Research Institute of National Defense, Stockholm; and Lars Hermodsson, University of Uppsala.

WEAPONS DIRECTOR -- (Photo at left) Brigadier General W. T. Ryder, Director of Special Weapons, Office of Chief of Research and Development, Department of the Army, asks Dr. Edward Freiling, Head, Physical Chemistry Branch, about the Chem Tech exhibits on the 6th floor.

CIVIL DEFENSE-MINDED -- (Center three, from left) Dr. Edward Teller, U. C., Dr. Willard Libby, UCLA, and Dr. Eugene Wigner, Princeton University, visited NRDL for Civil Defense-oriented presentations. Shown with them are (from left) CAPT E. B. Roth, Commanding Officer and Director; Dr. E. P. Cooper, Scientific Director; Dr. R. R. Newell, Medical Consultant; and Dr. E. R. Tompkins, Associate Scientific Director.

(A) INTENSE HEAT -- Fleet Admiral Ary dos Santos Rongel, Chief of the Naval General Staff of Brazil inspects firebrick exposed to an intense thermal source for a few seconds. The source simulated the thermal radiation from a nuclear weapon. Others are LCDR Z. Boghossian, Brazilian Liaison Officer to the U. S. Naval Mission; Dr. E. P. Cooper, Scientific Director; Dr. W. E. Kreger, Head, Nucleonics Div., and CAPT E. B. Roth, Commanding Officer and Director. They are holding shields used to protect their eyes during the test. (B) CHEM TECH INTEREST -- Brig. Gen. F. J. Delmore (second from right), Chemical Corps, USA, Commanding General, Chemical Corps Research and Development Command, listens to Dr. L. H. Gevantman explain the work of the Chem Tech Div. which he heads. From left are Dr. E. R. Tompkins, Associate Scientific Director, and CAPT Roth. (C) HOMELAND -- En route to the San Francisco Naval Shipyard to accept transfer of the USS ORCA (AVP-49) to the Ethiopian Navy, the defacto CNO, CDR A. Desta, grandson of Emperor Haile Sellassie I, visited NRDL. He points out his homeland to CAPT Roth and LTJG C. W. Kelly, III, BUDOCKS Program Officer, one of the tour guides.

"FROZEN LIGHTNING" -- During 1962 a number of distinguished visitors were presented a memento that has been adopted as a sort of trademark by us. Five of the recipients are pictured here with this small block of Lucite (a transparent synthetic resin) which incorporates what we call "frozen lightning." Technically speaking, this "frozen lightning" or "tree" is known as the Lichtenberg effect and is formed by an electrical discharge within the block following bombardment with high energy electrons from a Van de Graaff generator, linear accelerator or other suitable electron accelerator. (A) The new 12ND Commandant, RADM E.E. Yeomans, USN, at the completion of his first visit to NRDL, accepts the memento from



the Commanding Officer and Director, CAPT E. B. Roth, USN; as does (B) Lt. Gen. H. E. Knott, Director General of the British Army Medical Service; (C) VADM E. C. M. LeBreton, MC, Surgeon General of the French Navy (flanked by CAPT P. H. Bonnel, MC, French Navy, Chief, Technical Service Bureau of Medicine and Surgery; and CDR Edgar Neptune, Jr., MC, USN, who accompanied the visitors); and (D) the Surgeon General of the Brazilian Navy, VADM Waldyr C. Pires, MC, in the presence of CDR J. P. Maranhao, MC, Brazilian Aide-Assistant to Admiral Pires. (E) RADM Jean Guerin, French Naval Attache in Washington, D. C. was presented the memento by CDR T. L. Birch, Acting C.O. the day of the Admiral's visit. Standing by is Dr. E. P. Cooper, Scientific Director.

CHAPTER VIII -- PUBLICITY

Wide press, magazine, and TV coverage was given to the ONR 6th Navy Science Symposium hosted by this Laboratory on 2-3 May; Dr. Alpen's $5,000 SecNav Award; and the discovery by Dr. D. J. Kimeldorf and E. L. Hunt that ionizing radiation appears to have a direct stimulus effect on the mammalian nervous system. An article about the latter was carried also in TIME (6/1/62) and BUSINESS WEEK (6/12/62). The wire services picked up stories about Clay P. Butler's lead and cover story in the 26 October issue of SCIENCE. The article was entitled "The Light of the Atom Bomb." And numerous press releases were printed in Bay Area and home town papers about personnel who received awards, promotions, and the like. NRDL is mentioned in the article entitled "Navy's 'In-House' Research Laboratories," U. S. Naval Institute Proceedings (Feb. 1962).

Public interest in civil defense continued throughout 1962 with an upswing of requests during the Cuban crisis for information on fallout shelters and related concerns. The NRDL Shelter Model was loaned for display at the Santa Clara County Fair; the Engineering Society Exhibit in San Mateo; and Armed Forces Day at the Naval Supply Center, Stockton Annex. Edmund L. Lewis, Education and Information Division, California Disaster Office, wrote: "May I commend you and your staff for the excellent briefing held at Camp Parks for the State of California Education and Training Advisory Committee on Civil Defense.

MOVIES

The movies taken during the 48-hour Family Shelter test at Camp Parks in November 1960 were coordinated with a soundtrack and made into a 30-minute nationwide training film for the Office of Civil Defense.

Two three-minute movies were prepared for BUSHIPS on work done by NRDL -- (1) Decon; and (2) HYDRA II-A.

Under auspices of the United States Information Agency for showing in some 46 countries, a newsreel was produced at NRDL on "Thermal Research Studying the Effects of Intense Heat on Various Kinds of Matter." It appears in "Science Report" (produced twice a month for USIA), Issue 13-A, No. 5.

TV AND RADIO

On New Year's Eve Dr. Ralph W. Brauer, Head, Pharmacology Branch, appeared on KRON-TV's "Science in Action" program, presenting a discussion of liver physiology.

Earlier in the year CAPT E. B. Roth was an invited participant on the award-winning radio show "The Pelton Story," which explored the problems of public schools in slum neighborhoods.

CHAPTER IX -- MISCELLANEOUS

A one-day United Crusade was held at NRDL on 21 September with 97 per cent participation and over $4,000 donated. Laboratory members also donated $146.88 to the 1962 Navy Relief Society Fund Drive. And a group of women employees continued to make rag dolls to cheer children in the isolation ward at San Francisco City and County Hospital at Eastertime and Christmas.

Dr. R. R. Newell, Medical Consultant, and "Chick" Hayashi, Graphic Developments Branch, worked out a corporate seal for the National Council on Radiation Protection and Measurement, as shown at right. Dr. Newell is a member of this group. During the year Mr. Hayashi displayed some of his work at the Oakland Art Museum and won first prize at the 7th annual Walnut Creek Pageant of Arts. He conducts a lunch hour art class for NRDLERS.

Gerald Ferrier, HM1, Medical Department, went to San Diego as a member of the COM12 Pistol Team and won a berth on the Pacific Fleet Pistol Team and advanced to All Navy Matches.

LCDR C. H. Brown, MC, USNR, Head, Radiological Health Division, served as physician in attendance to the American Women's Team during the 4th USSR-USA Dual Track and Field Meet 21-22 July and at the Olympic Development Clinic held the week before at Stanford.

LCDR J. C. Bartlett, Head, Logistic Support Division, and former NRDLER LTJG W. E. Smith, IV, teamed up with two San Francisco Naval Shipyard officers to win the 12 ND Class "A" Tennis Championship.

Dr. Ken Lincoln, Radiation Effects Branch, continues as a member of the Board of Directors of DATA (Development and Technical Assistance International) after having served for the first two years as Chairman. Organized about three years, DATA has built up a corps of some 700 technical and professional consultants whose services are donated "on call" to help meet human needs in the area of their special training and interest. More than 1,200 problems have been solved for people in 85 countries. Clay P. Butler, Radiation Effects Branch, is a consultant.

A lounge was established on the second floor for the use of women employees, and "WE" put on the "finishing touches" with pictures and magazines.

AFTER HOURS -- NRDLERS and their families again attended the annual picnic and Christmas party, and participated in golf(above), bowling, fishing (left, below), and bridge tournaments. NRDL military men engaged in a volleyball tournament(right, below) on 5 April against officers of the Ethiopian Navy (the day before they left for Massaua on the Red Sea, where their Naval Academy is located). The Ethiopians had been at the San Francisco Naval Shipyard since January when the U. S. turned the USS ORCA (AVP-49) over to the Ethiopian Navy.